

## NOTES ON FOSSIL DIATOMS FROM NEW SOUTH WALES, AUSTRALIA. I.

FOSSIL DIATOMS FROM DIATOMACEOUS EARTH, COOMA, N.S.W.

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*(Communicated by Dr. A. B. Walkom.)*

(Twenty-six Text-figures.)

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The diatomaceous remains found in siliceous earths, clay, sands and similar deposits of the later geological periods have recently become of great importance in deciding whether these deposits were formed under marine, brackish-water or freshwater conditions, and even in ascertaining the proportion of salt contained in the water in which they were deposited. Moreover, as the geographical distribution of the living species of diatoms becomes known, valuable indications may be obtained from the presence of their remains, as to the climates that prevailed while the deposits which contain them were being laid down. The recent and the fossil diatomaceous floras of Australia have not yet been extensively studied. Investigations of the recent and fossil freshwater diatoms of Australia include those of G. I. Playfair (1915) on the diatomaceous flora of the Lismore district, G. S. West (1909) who described some forms from the environs of Melbourne, and Tempere and Peragallo (1915) on collections of fossil diatoms from Brunswick, Victoria, from Lake Mari, and from Talbot, Melbourne, and of fresh and brackish-water species from the Yarra River, Melbourne. A detailed investigation of the marine diatoms from the water off the coast of New South Wales has recently appeared (Dakin and Colefax, 1933). The present note is the result of the examination of diatomaceous earth from Cooma kindly sent to me by Mr. F. S. Mance of the New South Wales Department of Mines, Sydney. This deposit is situated about five miles from Cooma, and one and a half miles from Bunyan Platform, N.S.W. The following description of this deposit is given by Dr. W. R. Browne (1914, p. 205): "From test-holes which have been put down, the deposit is believed to cover an area of 30 acres. It is situated in a hollow on the western side of Middle Flat, surrounded on the north and west by a ridge of slates and mylonized quartz-porphry capped by Tertiary basalt. The deposit is close to the surface, being covered by 18 inches to 2 feet of alluvium, chiefly basaltic soil. Under this is about 2 feet of very hard buff-coloured "mullock", a kind of travertine containing numerous angular fragments of quartz and of diatomaceous earth. This is succeeded by another 2 feet of massive tripolite of a pale creamy-white colour, then comes 3 feet of layered tripolite—"slate", as it is called—which is slightly denser than the other and shows stratification. Under this the deposit is alternately massive and stratified. At intervals, pipes of roughly elliptical section occur, filled with a hard, brittle brown clay, in which remains of bones, etc., are often found. Veins of wood opal are fairly frequent, yellow, red, and green in colour, and very light and brittle." E. J. Kenny (1924, p. 12) gives analyses of three diatomites from Cooma. The diatomaceous earth from Cooma is whitish-cream in colour, very light, porous, somewhat friable, resembling chalk in general appearance. The study of the sample was done in my private laboratory

at Harbin. The crude material was first broken into small pieces and pulverized with Glauber's salt. For this the material was mixed with Glauber's salt and boiled several times during a week. The rapid crystallization of the salt breaks the pieces of diatomaceous earth into fine powder. Then the material was washed in distilled water and boiled in commercial hydrochloric acid, then washed again and boiled in commercial sulphuric acid. Then powdered potassium chlorate was slowly added to the boiling acid until the black colour gave place to white. Very thorough washing followed this to remove the last trace of acids and salts. The coarse pieces, as spicules of sponges and like impurities, are now removed by rotating the material in a glass tube. The diatoms were then preserved in 96% alcohol and mounted in Piperin-Cumaron and HgI<sub>2</sub> proposed by Dr. R. W. Kolbe of Berlin.

The following general features may be pointed out in connection with the examination of the algal flora of the Cooma diatomaceous earth:

1. The Cooma diatomaceous earth is probably of middle Tertiary age and of distinct lacustrine origin. In this earth ten species of diatoms have been recognized, together with many sponge spicules, some cysts of Chrysomonads and auxospores of undetermined diatoms. Most of the diatoms were present only as small filaments and could not be identified. Of the diatoms found, 25% are new; 60% of the algae belong to recent species, 30% are known as fossil from Lower Tertiary deposits.

2. In external appearance the diatomaceous earth exhibits a great degree of uniformity and consists of a large number of *Melosira granulata* and var. *angustissima*, a freshwater species reported as recent from the plankton of large lakes of temperate regions of Europe, America and Asia, and known as fossil in neogene deposits from Europe, Korea, Nippon, and North America. The other species are all infrequent and rare in the material from Cooma.

3. *Melosira undulata* var. *spiralis* is also a freshwater species reported as recent from tropical districts as Malaya, India, West India, Nippon, South China and Africa, and is widely known as fossil from neogene deposits from Europe, America, Northern China and Nippon. Our Cooma specimens differ from the type only in the structure of the frustules.

4. *Eunotia valida*, *Pinnularia viridis* var. *intermedia* and *Gomphonema longiceps* var. *subclavata* are all freshwater. *Stauroneis* (*Pleurostauron*) *Playfairiana* is a distinct species, probably also freshwater.

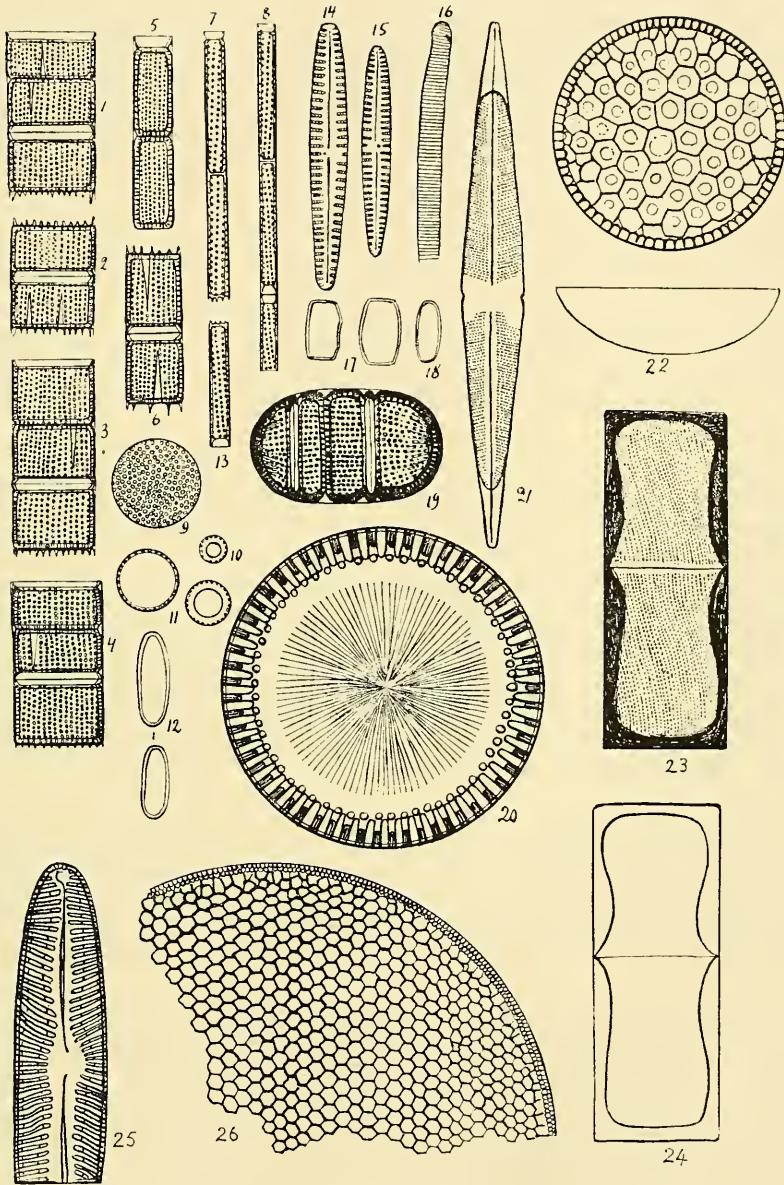
5. Large numbers of fragments of several kinds of diatoms belonging to the genera *Synedra*, *Fragilaria*, *Pinnularia*, *Cymbella* and others have been observed in the material but are not identifiable. They are all freshwater.

6. Three distinct marine diatoms have been recognized from Cooma. *Melosira sulcata* is common in Pacific, Atlantic and Arctic oceans and also reported as fossil from Lower Tertiary deposits from New Zealand, Tertiary deposits of Hungary, and from marine deposits of Simbirsk, Russia. *Coscinodiscus Wittianus* Pantocsek has been reported from Lower Tertiary deposits from Simbirsk, Russia, and *Coscinodiscus subconcarus* is also known from Tertiary deposits of European Russia. Future investigations may show whether the occurrence of these marine diatoms in the lacustrine diatomaceous earth is accidental.

#### *Description of the species.*

MELOSIRA GRANULATA (Ehr.) Ralfs. Text-figs. 1-6, 9, 11, 19.

Hustedt, Bacillar., 1930, pp. 87-88, fig. 44; Hustedt, Die Kieselalgen, 1927, Lief. 1, pp. 248-249, fig. 104 a-c. c. f.



Text-figs. 1-26.

1-6, *Melosira granulata* (Ehr.) Ralfs.—7, 8, *Melosira granulata* (Ehr.) Ralfs var. *angustissima* O. Mull.—9, *Melosira granulata* (Ehr.) Ralfs.—10, *Melosira granulata* (Ehr.) Ralfs var. *angustissima* O. Mull.—11, *Melosira granulata* (Ehr.) Ralfs.—12, Sporangial frustule of an unidentified diatom.—13, *Melosira granulata* (Ehr.) Ralfs var. *angustissima* O. Mull.—14, 15, *Gomphonema longiceps* Ehr. var. *subclavata* Grun. ?.—16, *Eunotia valida* Hustedt.—17, 18, Sporangial frustule of unidentified diatom.—19, *Melosira granulata* (Ehr.) Ralfs. Sporangial frustule.—20, *Melosira sulcata* (Ehr.) Kutz.—21, *Stauroneis* (*Pleurostauron*) *Playfairiana*, n. sp.—22, *Coscinodiscus subconcausus* Grun.—23, 24, *Melosira undulata* (Ehr.) Kutz. var. *spiralis*, n. var.—25, *Pinnularia viridis* (Nitzsch.) Ehr. var. *intermedia* Cleve ?.—26, *Coscinodiscus Wittianus* Pant.

The drawings were made with E. Leitz Apochromat 2 mm. and compens. ocular 4.



Valve cylindrical with distinct pseudosulcus and sulcus. Edge of disc with spines, usually small, sometimes large. Frustule membrane thick, with large granules in longitudinal, sometimes spiral, lines. Frustule height 0.0085 to 0.02 mm.; breadth, 0.0068 to 0.0187 mm. Rows of granules 9 to 10, granules in rows 9 to 13 in 0.01 mm. Abundant. A freshwater diatom reported from plankton of lakes. Known as fossil from neogene deposits of Europe, North America, and recently from Korea, and Nippon (Saga Prefecture).

MELOSIRA GRANULATA (Ehr.) Ralfs var. ANGUSTISSIMA O. Mull. Text-figs. 7, 8, 10, 13.

Hustedt, Bacillar., 1930, p. 88, fig. 45; Hustedt, Die Kieselalgen, 1927, p. 250, fig. 104d.

Valve linear-cylindrical. Frustule height 0.02 to 0.022 mm.; breadth, 0.0034 to 0.005. Rows of granules 9, granules in rows 10 to 12 in 0.01 mm. Common with the type. Reported from plankton of large lakes, and fossil from neogene deposits. Recently found in neogene deposits of Chosen, Korea, Nippon.

MELOSIRA UNDULATA (Ehr.) Kutz. var. SPIRALIS, n. var. Text-figs. 23, 24.

Differt a typo striis spiralis non parallelis, 18 in 0.01 mm. Punctis 20 in 0.01 mm. Punctis robustis solitariis juxta discum absunt. Habit.: In stratis tertiariis aquae dulcis prope Cooma, New South Wales, Australia.

Frustules single or in twos, usually longer than broad, with thick membrane constricted near the margin. Pseudosulcus and sulcus indistinct. Surface of the valve with spiral lines of puncta. No large puncta near the edge of the disc. Frustule height 0.025 to 0.027 mm.; breadth, 0.01 mm. Rows of puncta 18, puncta in rows 20 in 0.01 mm. Differs from the type and varieties in its spiral, not parallel, lines of puncta and by the absence of large puncta near the edge of the disc. Infrequent. *Melosira undulata* is a freshwater form and is common in tropical districts; it is also known as fossil in neogene deposits of Europe, North America, Shantung, N. China, and Nippon.

MELOSIRA SULCATA (Ehr.) Kutz. Text-fig. 20.

Van Heurck, Synopsis, 1881, Taf. 91, figs. 15, 16; A. Schmidt, Atlas Diatom., 1882, Taf. 176, figs. 28, 32-39, 42-44, 46; Taf. 178, figs. 1-5, 7-19, 22-24.—*Melosira sulcata* Ehr. var. *sibirica* Grun., Witt, Ueber den Polierschiefer von Archangelsk-Kurojedowo im Gouvern. Simbirsk, 1885, 28, Taf. X, fig. 2.—*Melosira sulcata* Ehr. f. *radiata* Grun., Peragallo, Les Diatomées Marine de France, 448, Pl. 119, fig. 12.

Valve circular, robust, 0.068 to 0.075 mm. in diameter, separated into three areas. The marginal area, about one-ninth of the diameter of the valve, is formed of robust radiating plates, shorter and longer, striped lengthwise with a series of large rounded dots between the large plates in the inner part of the area. Marginal plates 4 to 5 in 0.01 mm. The median area, also about one-ninth of the valve diameter, is hyaline, and the central area, about two-thirds of the valve diameter, is covered with fine radiating rows, about 8 to 9 in 0.01 mm. Infrequent. A marine species, recent and fossil. Reported from Lower Tertiary deposits from New Zealand, also from Tertiary deposits of Hungary and of Simbirsk, European Russia.

COSCINODISCUS WITTLANUS Pant. Text-fig. 26.

Beitrag zur Kenntniss der Fossilen Bacillarien Ungarns, 1903, 120.—*Coscinodiscus lineatus* O. Witt (nec Ehrenberg), Ueber den Polierschiefer von Archangelsk-Kurojedowo im Gouvern. Simbirsk, 1885, 23, Tab. I, fig. 6.

Valve circular. Surface towards the centre flat, slightly convex near the border. Markings hexagonal, 2.5 to 3 in 0.01 mm., subequal, at border 8-9 in 0.01 mm. Central dots of the markings indistinct; apiculi absent. Border narrow, with small markings, without radiating striae. Diameter 0.119 to 0.122 mm. Infrequent. Differs from the type in larger size of the valve and more robust markings.

*COSCINODISCUS SUBCONCAVUS* Grun. Text-fig. 22.

Ratray, A revision of the Genus *Coscinodiscus* Ehr. and of some allied genera, 1890, 466; A. Schmidt, Atlas Diatom., 1878, Pl. 59, figs. 12, 13.

Frustule convex, about 0.037 mm. in diameter. Valve circular, covered with large hexagonal markings, decreasing but slightly from the centre outwards, about 2 in 0.01 mm. Central dots distinct. Border narrow, showing evident short radial lines. Rare. Reported from Lower Tertiary deposits of Simbirsk, European Russia.

*EUNOTIA VALIDA* Hust. Text-fig. 16.

Hustedt, Bacillar., 1930, 178-179, fig. 229.

Valve linear, slightly curved, with parallel margins and slightly capitate ends. Length, 0.045 mm.; breadth, 0.005 mm. Striae about 12 in 0.01 mm. Infrequent. A freshwater species reported from Europe.

*STAURONEIS (PLEUROSTAUROX) PLAYFAIRIANA*, n. sp. Text-fig. 21.

Valvis lanceolatis angustis, ad medium modice inflatis cum polis cuneatis et subacutis. Area axillaris angustis linearis ad polos laculamentis ornatis, area centralis ad porum centralem transverse dilatatus. Striis transversis radiantes, punctatis, 16-18, punctis 15 in 0.01 mm. Polos hyalinis, raphe directis. Valvis longis 0.075-0.09 mm.; latis 0.009-0.01 mm. Habit.: In stratis lacustris tertiariis prope Cooma, New South Wales, Australia.

Valve linear-lanceolate, tapering from the middle part to the long acute ends. In the middle part of the valve the margin slightly interrupted. Both ends with transverse round siliceous ribs. Median line straight. Central pores distinct. Axial area narrow linear, central area a transverse dilated fascia. Striae radiate, 16-18 in 0.01 mm. Puncta distinct, about 15 in 0.01 mm. Length, 0.075 to 0.09 mm.; breadth, 0.009 to 0.01 mm. Differs from *Stauroneis (Pleurostauron) acuta* in its long acute ends. Infrequent. Named in honour of the late G. I. Playfair.

*PINNULARIA VIRIDIS* (Nitz.) Ehr. var. *INTERMEDIA* Cleve (?). Text-fig. 25.

Cleve, Synopsis of the Navicul. Diatoms, 1894, I, 91; Pantocsek, Beiträge zur Kenntniss der Fossilen Bacillarien Ungarns, 1903, iii, Pl. 7, fig. 119.

Valve elliptical-linear with margins attenuated towards rounded ends. Length, 0.072 mm.; breadth, 0.0136 mm. Median line robust, indistinctly complex. Terminal fissures comma-shaped. Axial area linear, about one-fourth of the breadth of the valve, widened around the central nodule. Striae 8 in 0.01 mm., divergent in the middle and convergent at the ends. Longitudinal band distinct. Infrequent. A freshwater diatom, reported also as fossil.

*GOMPHONEMA LONGICEPS* Ehr. var. *SUBCLAVATA* Grun. (?). Text-figs. 14, 15.

Hustedt, Bacillar., 1930, 375, fig. 705.—*Gomphonema subclavatum* Grun., Van Heurck, Synopsis, 1880, Pl. 23, fig. 37.

Valve lanceolate, clavate, with one end broader than the other. Apex attenuate and acute. Length 0.0357 to 0.0476 mm.; breadth 0.005 to 0.006 mm. Striae robust,

almost parallel, at the end slightly radiate, 6 to 10 in 0.01 mm. Infrequent. A freshwater diatom common in mountain districts, and also reported as fossil.

*Sporangial frustules of an unidentified diatom, probably of ATTHEYA sp.*

Text-figs. 12, 17, 18.

Cells in front view barrel-shaped, in side view elliptical, with thick smooth membrane. Cell in front view 0.009-0.01 to 0.005-0.0068 mm., in side view 0.0042-0.0051 to 0.0085-0.0187 mm. Common.

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